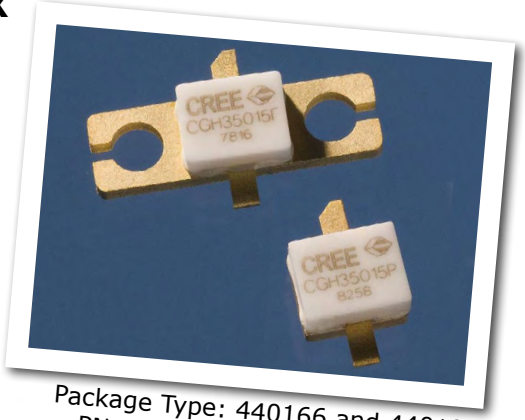
CGH35015

15 W, 3300-3900 MHz, 28V, GaN HEMT for WiMAX

Cree's CGH35015 is a gallium nitride (GaN) high electron mobility transistor designed specifically for 802.16-2004 WiMAX Fixed Access applications. GaN HEMTs offer high efficiency, high gain and wide bandwidth capabilities, which makes the CGH35015 ideal for 3.3-3.9GHz WiMAX and BWA amplifier applications. The transistor is available in both screw-down, flange and solder-down, pill packages.



Package Type: 440166 and 440196
PN: CGH35015F and CGH35015P

Typical Performance Over 3.3-3.8GHz (T_C = 25°C) of Demonstration Amplifier

Parameter	3.3 GHz	3.4 GHz	3.5 GHz	3.6 GHz	3.7 GHz	3.8 GHz	Units
Small Signal Gain	13.6	12.8	12.3	12.2	12.3	12.8	dB
EVM at P_{AVE} = 24 dBm	2.71	2.31	2.1	2.12	2.54	3.04	dBm
EVM at P_{AVE} = 33 dBm	2.63	2.29	1.93	1.70	1.70	2.14	dBm
Drain Efficiency at P_{AVE} = 33 dBm	24.0	25.5	26.1	25.6	23.8	2.38	%

Note:
Measured in the CGH35015F-TB amplifier circuit, under 802.16 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, 5 ms Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3, PAR = 9.8 dB @ 0.01 % Probability on CCDF.

Features

RoHS COMPLIANT

- 3.3 - 3.9 GHz Operation
- 15 W Peak Power Capability
- 12 dB Small Signal Gain
- 2.0 W P_{AVE} at < 2.0 % EVM
- 26 % Efficiency at 2 W Average Power
- WiMAX Fixed Access 802.16-2004 OFDM
- WiMAX Mobile Access 802.16e OFDMA

Large Signal Models Available for SiC & GaN

Subject to change without notice.
www.cree.com/wireless

Absolute Maximum Ratings (not simultaneous) at 25˚C Case Temperature

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	V_{DSS}	84	Volts	25˚C
Gate-to-Source Voltage	V_{GS}	-10, +2	Volts	25˚C
Power Dissipation	P_{DISS}	7	Watts	
Storage Temperature	T_{STG}	-65, +150	˚C	
Operating Junction Temperature	T_J	225	˚C	
Maximum Forward Gate Current	I_{GMAX}	4.0	mA	25˚C
Maximum Drain Current[1]	I_{DMAX}	1.5	A	25˚C
Soldering Temperature[2]	T_S	245	˚C	
Screw Torque	τ	60	in-oz	
Thermal Resistance, Junction to Case[3]	$R_{\theta JC}$	8.0	˚C/W	85˚C
Case Operating Temperature[3]	T_C	-40, +150	˚C	30 seconds

Note:
[1] Current limit for long term, reliable operation.
[2] Refer to the Application Note on soldering at www.cree.com/products/wireless_appnotes.asp
[3] Measured for the CGH35015F at P_{DISS} = 7 W.

Electrical Characteristics (T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics[1]						
Gate Threshold Voltage	$V_{GS(th)}$	-3.8	-3.0	-2.3	V_{DC}	V_{DS} = 10 V, I_D = 3.6 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.7	–	V_{DC}	V_{DS} = 28 V, I_D = 60 mA
Saturated Drain Current	I_{DS}	2.9	3.5	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	120	–	–	V_{DC}	V_{GS} = -8 V, I_D = 3.6 mA
RF Characteristics[2,3] (T_C = 25˚C, F_0 = 3.5 GHz unless otherwise noted)						
Small Signal Gain	G_{SS}	10.5	12	–	dB	V_{DD} = 28 V, I_{DQ} = 100 mA
Drain Efficiency[4]	η	22	26	–	%	V_{DD} = 28 V, I_{DQ} = 100 mA, P_{AVE} = 2.0 W
Back-Off Error Vector Magnitude	EVM_1	–	2.5	–	%	V_{DD} = 28 V, I_{DQ} = 100 mA, P_{AVE} = 18 dBm
Error Vector Magnitude	EVM_2	–	2.5	–	%	V_{DD} = 28 V, I_{DQ} = 100 mA, P_{AVE} = 2.0 W
Output Mismatch Stress	VSWR	–	–	10 : 1	Ψ	No damage at all phase angles, V_{DD} = 28 V, I_{DQ} = 100 mA, P_{AVE} = 2.0 W
Dynamic Characteristics						
Input Capacitance	C_{GS}	–	4.5	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Output Capacitance	C_{DS}	–	1.3	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	0.2	–	pF	V_{DS} = 28 V, V_{gs} = -8 V, f = 1 MHz

Notes:
[1] Measured on wafer prior to packaging.
[2] Measured in the CGH35015F-TB test fixture.
[3] Under 802.16 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, 5 ms Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3, PAR = 9.8 dB @ 0.01 % Probability on CCDF.
[4] Drain Efficiency = P_{OUT} / P_{DC}.

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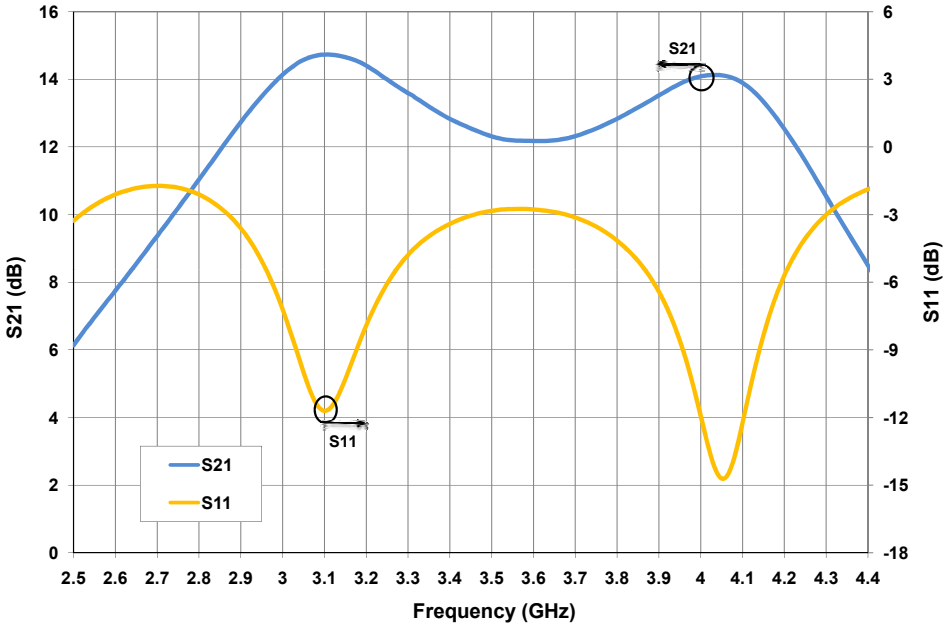
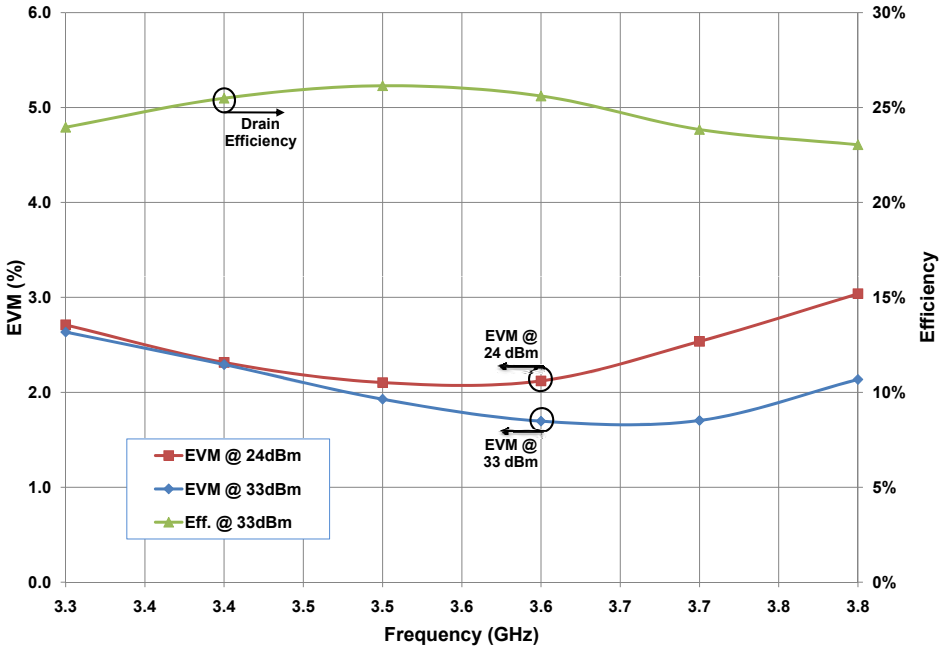
Typical WiMAX Performance

Small Signal S-Parameters vs Frequency of CGH35015F in the CGH35015F-TB
V_{DD} = 28 V, I_{DQ} = 100 mA



Typical EVM and Efficiency versus Frequency of CGH35015F in the CGH35015F-TB
V_{DD} = 28 V, I_{DQ} = 100 mA, 802.16-2004 OFDM, PAR=9.8 dB



Note:
Under 802.16 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3.

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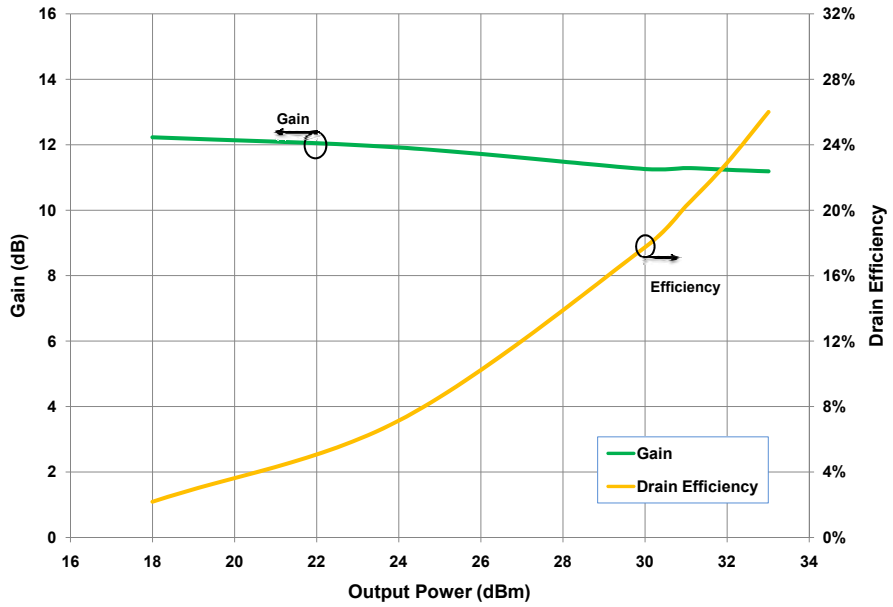
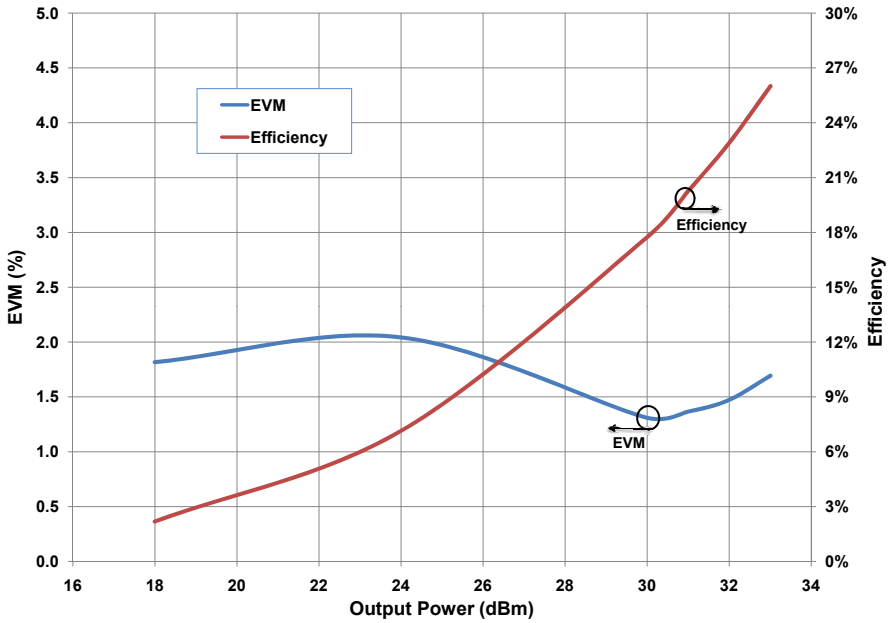
Typical WiMAX Performance

Drain Efficiency and Gain vs Output Power of the CGH35015F in the CGH35015F-TB
V_{DD} = 28 V, I_{DQ} = 100 mA, 802.16-2004 OFDM, PAR = 9.8 dB



Typical EVM and Efficiency versus Power Output of CGH35015F in the CGH35015F-TB
V_{DD} = 28 V, I_{DQ} = 100 mA, 802.16-2004 OFDM, PAR=9.8 dB



Note:
Under 802.16-2004 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3.

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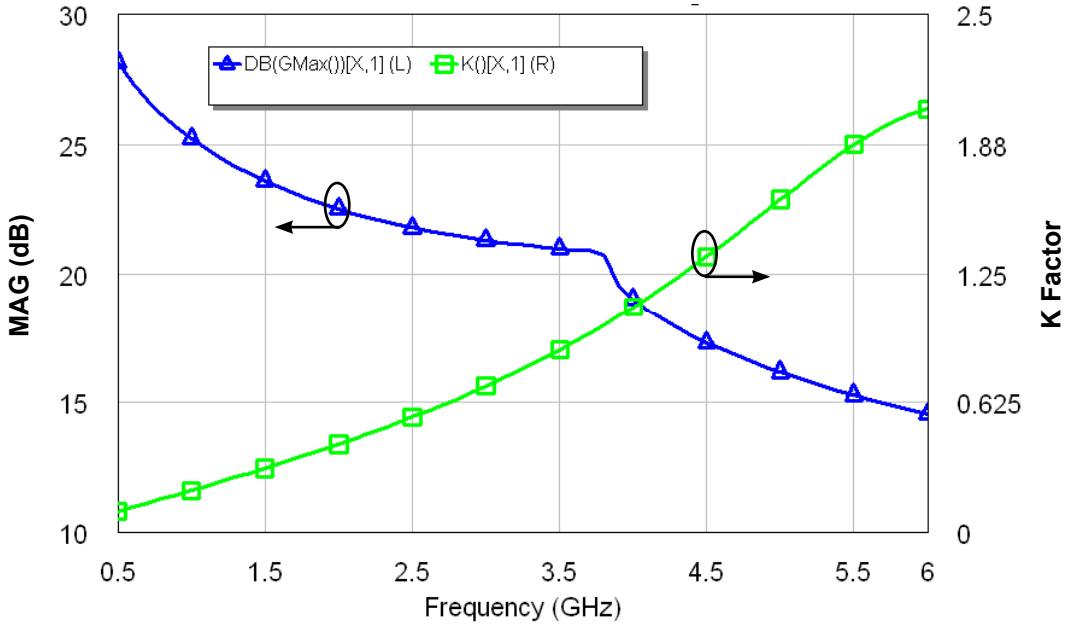
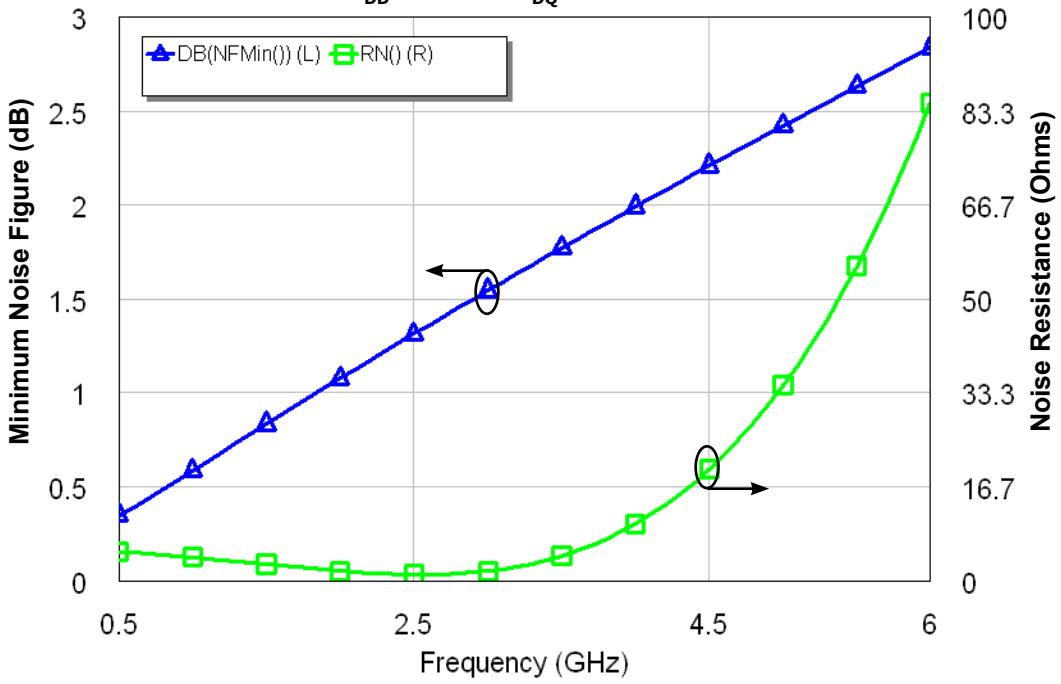
Typical Performance

Simulated Maximum Available Gain and K Factor of the CGH35015
V_{DD} = 28 V, I_{DQ} = 100 mA



Typical Noise Performance

Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH35015
V_{DD} = 28 V, I_{DQ} = 100 mA



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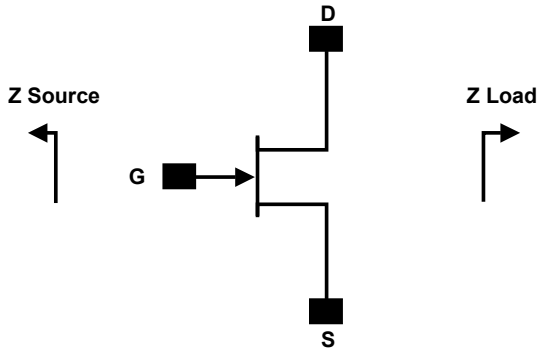
Source and Load Impedances



Frequency (MHz)	Z Source	Z Load
3300	13.0 - j5.6	13.2 - j2.8
3400	17.2 - j6.0	13.2 - j2.8
3500	20.8 - j9.9	13.1 - j2.9
3600	20.1 - j15.8	13.1 - j3.3
3700	15.7 - j19.0	12.3 - j3.8

Note 1. V_{DD} = 28V, I_{DQ} = 115 mA in the 440166 package.
Note 2. Impedances are extracted from the CGH35015-TB demonstration amplifier and are not source and load pull data derived from the transistor.

Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Test Methodology
Human Body Model	HBM	1A (> 250 V)	JEDEC JESD22 A114-D
Charge Device Model	CDM	II (200 < 500 V)	JEDEC JESD22 C101-C

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CGH35015-TB Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
C1,C2	CAP, 0.8pF, +/-0.1 pF, 0603, ATC 600S	2
C10,C11	CAP, 2.4pF,+/-0.1pF, 0603, ATC 600S	2
C4,C12	CAP, 10.0pF, +/-5%, 0603, ATC 600S	1
C5,C13	CAP, 39 PF±5%, 0603, ATC 600S	2
C14	CAP, 100 PF±5%, 0603, ATC 600S	1
C6	CAP, 470 PF ±10%,100 V, 0603	1
C7,C15	CAP, 33000PF, 100V, 0805, X7R	2
C8	CAP, 10UF, 16V, SMT, TANTALUM (240096)	1
C16	CAP, 1.0UF ±10%, 100V, 1210, X7R	1
C17	CAP, 33UF, 100V, ELECT, FK, SMD	1
R3	RES, 1/16W, 0603, 22 Ohms ≤5%	1
R4	RES, 1/16W, 0603, 100 Ohms ≤5%	1
J1	5-PIN, MOLEX, MALE, CONNECTOR	1
J2	2-PIN, MOLEX, MALE, CONNECTOR	1
J3,J4	SMA, FEMALE, CONNECTOR	2
-	PCB, RO4350B, Er = 3.48, h = 20 mil	1
-	CGH35015F or CGH35015P	1

CGH35015F-TB Demonstration Amplifier Circuit

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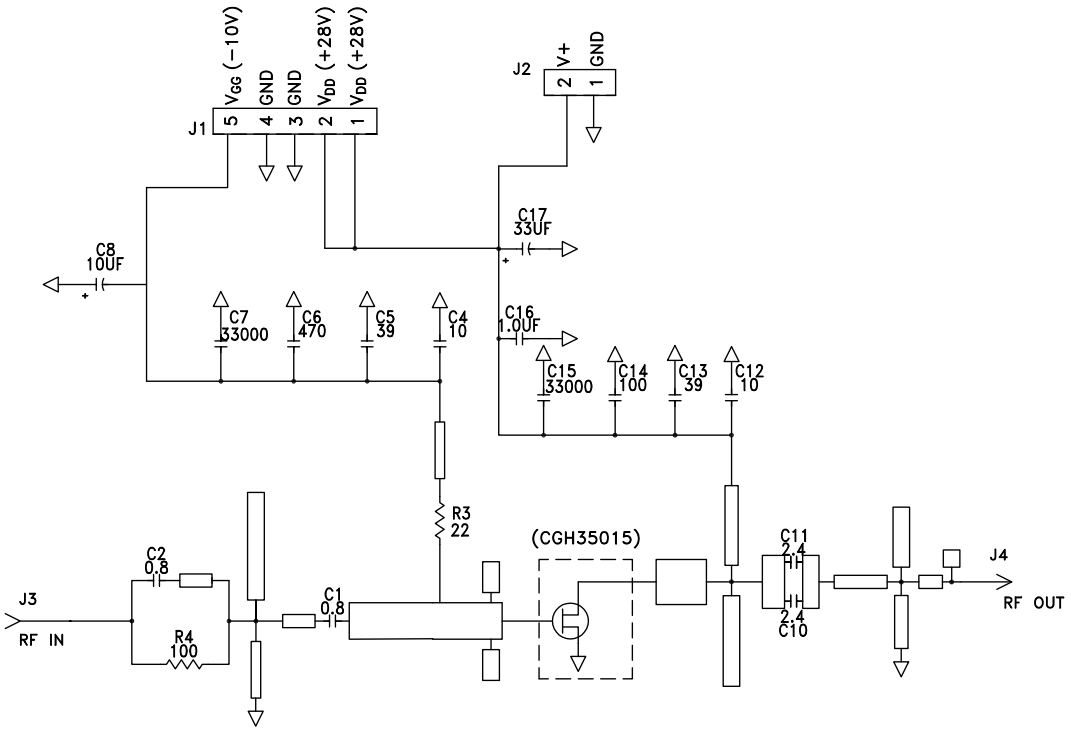
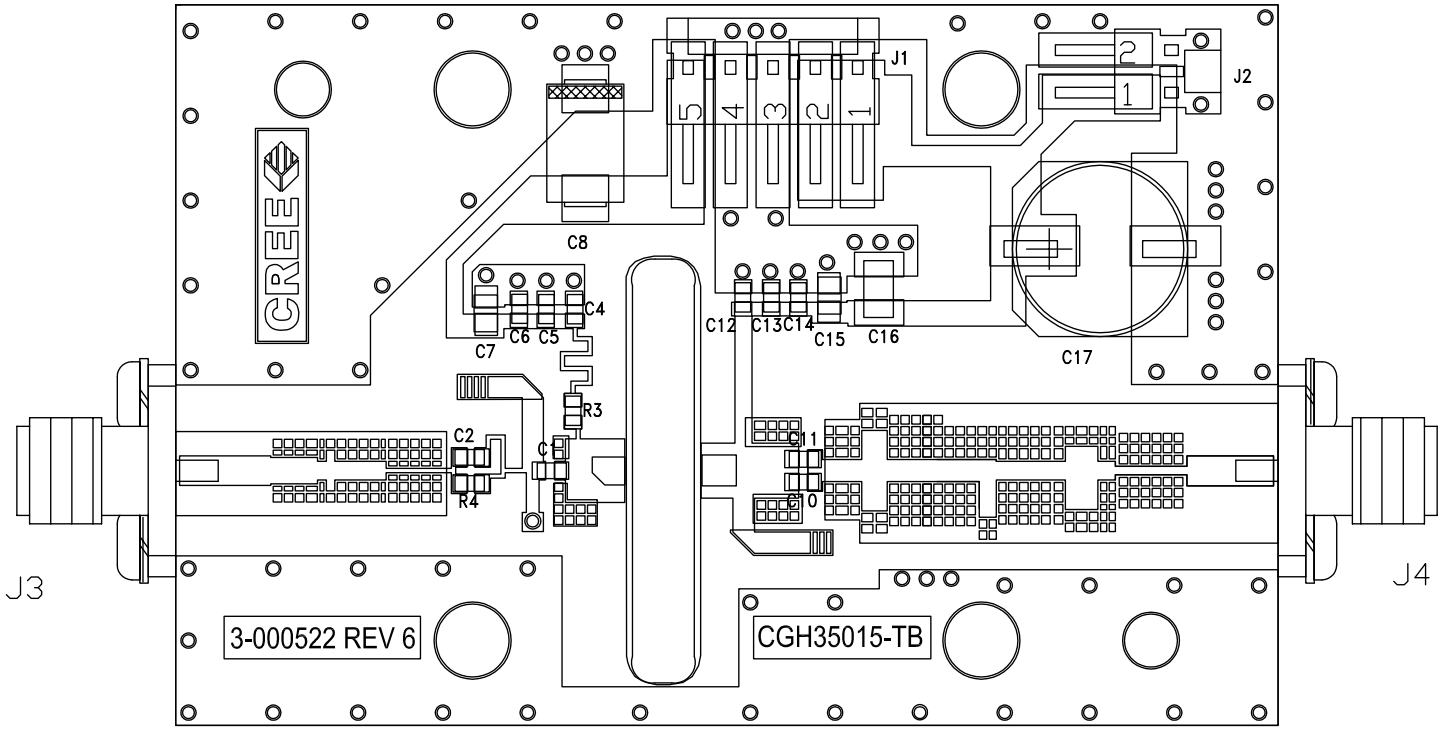
CGH35015-TB Demonstration Amplifier Circuit Schematic



CGH35015-TB Demonstration Amplifier Circuit Outline



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Typical Package S-Parameters for CGH35015
(Small Signal, V_{DS} = 28 V, I_{DQ} = 100 mA, angle in degrees)

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.909	-124.41	17.41	107.81	0.026	21.06	0.335	-93.73
600 MHz	0.902	-134.04	15.04	101.48	0.027	15.39	0.322	-101.61
700 MHz	0.898	-141.62	13.18	96.16	0.028	10.74	0.315	-107.78
800 MHz	0.894	-147.78	11.71	91.54	0.028	6.79	0.312	-112.73
900 MHz	0.892	-152.91	10.51	87.43	0.028	3.35	0.312	-116.77
1.0 GHz	0.890	-157.30	9.53	83.68	0.028	0.28	0.314	-120.15
1.1 GHz	0.889	-161.12	8.71	80.20	0.028	-2.51	0.318	-123.04
1.2 GHz	0.889	-164.51	8.01	76.95	0.028	-5.07	0.322	-125.57
1.3 GHz	0.888	-167.56	7.41	73.86	0.028	-7.45	0.328	-127.82
1.4 GHz	0.888	-170.34	6.89	70.91	0.028	-9.69	0.335	-129.87
1.5 GHz	0.888	-172.91	6.44	68.07	0.028	-11.81	0.342	-131.77
1.6 GHz	0.888	-175.30	6.04	65.32	0.028	-13.82	0.349	-133.56
1.7 GHz	0.888	-177.55	5.69	62.65	0.027	-15.74	0.357	-135.25
1.8 GHz	0.888	-179.68	5.37	60.05	0.027	-17.58	0.364	-136.89
1.9 GHz	0.888	178.29	5.09	57.50	0.027	-19.34	0.373	-138.48
2.0 GHz	0.888	176.34	4.83	55.01	0.027	-21.04	0.381	-140.03
2.1 GHz	0.889	174.45	4.60	52.56	0.026	-22.69	0.389	-141.55
2.2 GHz	0.889	172.63	4.39	50.14	0.026	-24.27	0.397	-143.06
2.3 GHz	0.889	170.84	4.20	47.76	0.026	-25.80	0.405	-144.56
2.4 GHz	0.889	169.10	4.02	45.41	0.025	-27.28	0.413	-146.04
2.5 GHz	0.890	167.39	3.86	43.09	0.025	-28.70	0.421	-147.52
2.6 GHz	0.890	165.71	3.71	40.79	0.025	-30.08	0.429	-149.00
2.7 GHz	0.891	164.04	3.57	38.51	0.024	-31.41	0.437	-150.48
2.8 GHz	0.891	162.39	3.44	36.26	0.024	-32.69	0.445	-151.95
2.9 GHz	0.891	160.76	3.32	34.01	0.024	-33.92	0.452	-153.43
3.0 GHz	0.892	159.13	3.21	31.79	0.023	-35.10	0.459	-154.92
3.2 GHz	0.892	155.89	3.00	27.38	0.023	-37.31	0.473	-157.90
3.4 GHz	0.893	152.65	2.83	23.00	0.022	-39.32	0.486	-160.90
3.6 GHz	0.893	149.39	2.67	18.66	0.021	-41.09	0.499	-163.93
3.8 GHz	0.894	146.09	2.54	14.34	0.020	-42.63	0.510	-166.99
4.0 GHz	0.894	142.74	2.41	10.02	0.020	-43.90	0.521	-170.10
4.2 GHz	0.895	139.33	2.31	5.70	0.019	-44.88	0.530	-173.24
4.4 GHz	0.895	135.84	2.21	1.37	0.018	-45.53	0.539	-176.45
4.6 GHz	0.895	132.26	2.12	-2.98	0.018	-45.84	0.547	-179.71
4.8 GHz	0.895	128.59	2.04	-7.36	0.017	-45.78	0.554	176.97
5.0 GHz	0.895	124.80	1.97	-11.79	0.016	-45.32	0.561	173.56
5.2 GHz	0.895	120.90	1.91	-16.27	0.016	-44.47	0.566	170.07
5.4 GHz	0.895	116.87	1.85	-20.81	0.016	-43.25	0.571	166.48
5.6 GHz	0.895	112.70	1.80	-25.41	0.015	-41.72	0.575	162.78
5.8 GHz	0.895	108.38	1.75	-30.10	0.015	-39.97	0.579	158.96
6.0 GHz	0.895	103.92	1.70	-34.88	0.016	-38.13	0.581	155.00

Download this s-parameter file in ".s2p" format at http://www.cree.com/products/wireless_s-parameters.asp

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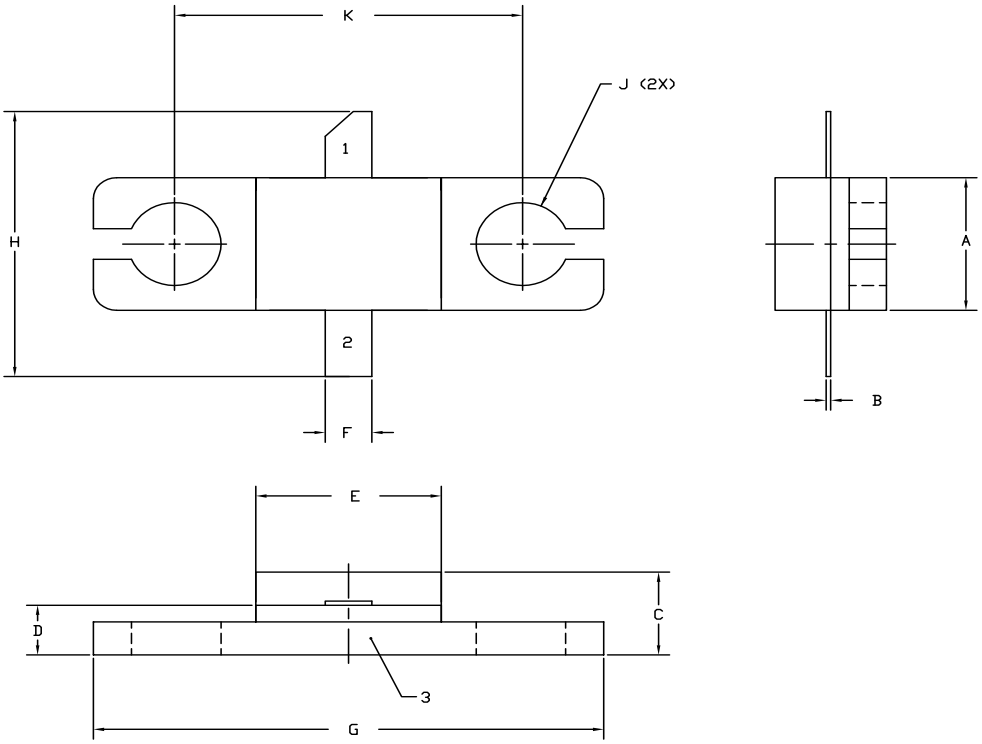
Product Dimensions CGH35015F (Package Type — 440166)



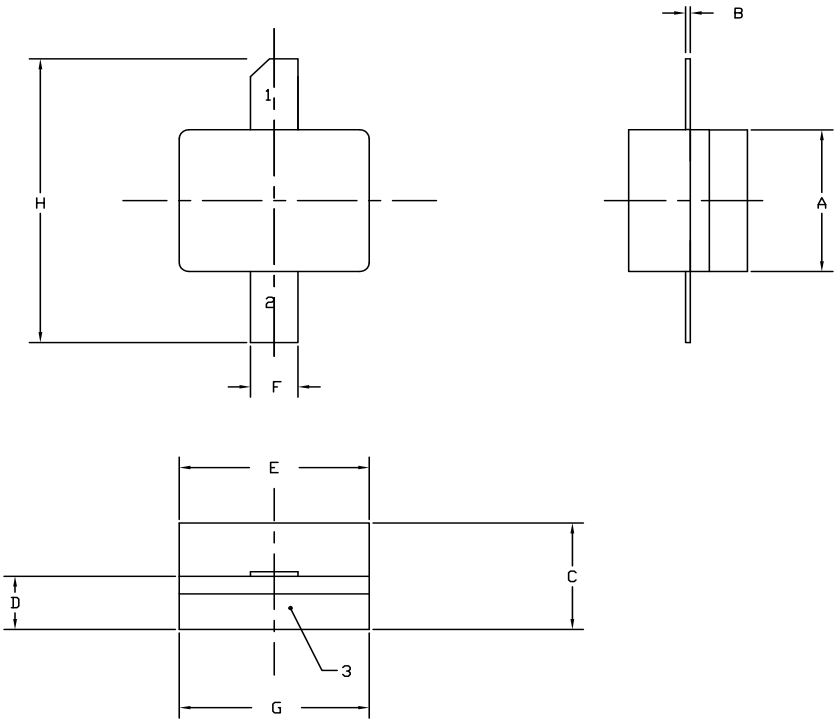
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
5. ALL PLATED SURFACES ARE NI/AU

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.155	0.165	3.94	4.19
B	0.004	0.006	0.10	0.15
C	0.115	0.135	2.92	3.43
D	0.057	0.067	1.45	1.70
E	0.195	0.205	4.95	5.21
F	0.045	0.055	1.14	1.40
G	0.545	0.555	13.84	14.09
H	0.280	0.360	7.11	9.14
J	ø .100		2.54	
K	0.375		9.53	

PIN 1. GATE
PIN 2. DRAIN
PIN 3. SOURCE

Product Dimensions CGH35015P (Package Type — 440196)



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DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.155	0.165	3.94	4.19
B	0.003	0.006	0.10	0.15
C	0.115	0.135	2.92	3.17
D	0.057	0.067	1.45	1.70
E	0.195	0.205	4.95	5.21
F	0.045	0.055	1.14	1.40
G	0.195	0.205	4.95	5.21
H	0.280	0.360	7.11	9.14

PIN 1. GATE
PIN 2. DRAIN
PIN 3. SOURCE

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